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ABSTRACT

During the past two decades, there have been several highly visible developments in education, including behavioral objectives, criterion-referenced test interpretations, the mastery model in instruction, performance-based instructional programs, competency testing, and accountability. This paper is an attempt to weave these various developments into a meaningful model of interrelationships and to explore the implications of that model in terms of teaching, testing, and grading. Major topics covered include: manifestations of individual differences, types of subject matter content, types of instruction, types of instructional objectives (behavioral minimal essential objectives and mentalistic developmental objectives), types of tests, types of test interpretations, and types of test scores. Juxtaposed to these topics, in a matrix format, are model tracks conceptualizing the following: (1) entire content of a small, closed domain that is readily specified in behavioral terms and content that is vital and masterable; (2) task readily specified in behavioral terms, but incapable of mastery or not important enough to merit mastery; and (3) content of large and/or open domain that cannot be specified in detail or mastered but can be illustrated in behavioral terms. The model is provided to enable practitioners to make decisions concerning which parts of a specific course fit the teaching, testing, and grading models of the three tracks. (TJH)

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Matching Instructional Objectives, Subject Matter, Tests, and Score Interpretations

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U.S. DEPARTMENT OF EDUCATION
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"Sometimes there's nothing more practical than a good theory."
Attributed to Kurt Lewin

During the past two decades there have been several highly visible developments in education (e.g., behavioral objectives, criterion-referenced test interpretations, the mastery model of instruction, performance-based instructional programs, competency testing, and accountability). This paper is an attempt to weave these various developments into a meaningful model of interrelationships and to explore the implications of that model for teaching, testing, and grading.

The paper treats seven major topics:

1. Manifestations of Individual Differences
2. Types of Subject Matter Content
3. Types of Instruction
4. Types of Instructional Objectives
5. Types of Tests
6. Types of Test Interpretations
7. Types of Test Scores

Table 1 summarizes these relationships. The order in which the topics are presented in Table 1 has been modified to reflect the sequence of considerations that one would most likely follow in making instructional decisions about a course or unit.

1. Individual Differences

If there is anything that psychologists agree upon, it is that individuals differ. This has profound implications for instruction. Effective teaching helps all students develop their talents to the maximum; it *increases individual differences*. The more talented students learn more than the less talented. Thus, effective teaching at the college level is reflected in *different levels of achievement* by different students.

If the material being taught is essential and must be mastered by all of the students, e.g., certain basic language skills or math skills, then *different amounts of time* will be required by different students to achieve mastery. A major purpose of this paper is to focus attention on individual differences, thereby providing a framework in which instructors can appropriately deal with individual differences in their teaching, wisely choosing when to channel them into the level-of-achievement dimension and when to channel them into the time-it-takes-to-master dimension.

In Table 1, individual differences in Track A are revealed in the amount of time required by different students to master the subject matter. In Track C, individual differences are channeled into different levels of achievement.

2. Types of Subject Matter

Subject matter at the college level can be categorized in various ways. For the purpose of this paper we are going to consider two dimensions of subject matter: the *degree* to which the content or domain can be *specified* and the *degree* to which the content or domain can be *mastered*.

It may be helpful to think of the domain as a set of content elements (e.g., specific facts, skills, or attitudes) that we want students to learn. For example, there are 32 letters in the Russian alphabet. Therefore, the set of 64 upper- and lower-case letter forms completely specifies the domain for the Russian alphabet. Because the domain is relatively small, it is masterable, i.e., all the letters can be learned. Moreover, knowing the alphabet is *essential* to students studying Russian. On the other hand, all of the vocabulary in a particular unabridged Russian dictionary can be completely specified, but cannot be mastered. (This example is somewhat artificial. Although strictly speaking there is a finite number of words in a dictionary, the number of words in a language is virtually infinite). Finally, when we come to appreciating Russian literature, we cannot completely specify the content domain. We cannot define everything we hope the students will learn; nor can we meaningfully specify a level of mastery, a point beyond which one should learn no more. The set of elements in this domain is infinite.

Editor's Note: This IDEA Paper differs from several of the more recent ones in that it is more theoretical and abstract. Yet it provides a useful frame of reference for many practical instructional decisions. In addition, it lays a necessary foundation for the next IDEA Paper, which will deal with "Improving College Grading."

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Table 1.
Relationships among Types of Content, Manifestations of Individual Differences, Types of Instructional Objectives, Types of Instruction, Types of Test, Types of Score, and Types of Interpretation

Track	Subject Matter	Manifestation of Individual Differences	Instructional Objective	Instruction	Test	Score	Interpretation	Examples
A								
B								
C								

These considerations give rise to three kinds of subject matter that relate to the three tracks in Table 1:

TRACK A—the entire content is completely *specifiable*, is *masterable*, and is *essential*.
TRACK B—the entire content is tightly specifiable, but either *cannot* be mastered or *need not be mastered*.
TRACK C—the content can neither be completely *specified nor mastered*.

At the college level, most subject matter falls in Track C, with only limited amounts in Tracks A or B. Track B occurs less frequently, yet it is useful with courses that require certain psychomotor skills. For example, the rules governing the 100-meter dash (the domain) are tightly specified, but there is no limit to how fast one would want to run; the faster, the better. And mastery—running in zero seconds—is impossible. Track B is also useful for content that could be mastered, but is not important enough to merit being mastered, e.g., memorizing the names and dates of all the rulers of Russia. Our remaining discussion will focus on Tracks A and C.

3. Types of Instruction

These different kinds of subject matter require different instructional approaches. The most effective way to teach Track A material is by *drill or extensive learning*, e.g., students memorize the letters of the Russian alphabet and write them over and over until they can form each letter so others recognize it. Using a different example, learning to load a program onto a personal computer is Track A content. The way to teach it is to have the students practice and practice until they succeed every time.

Regarding Track C material, we are primarily interested in broad, general goals, objectives that we can never completely define. Much of the material we teach is a sample, or examples, of what we want students to learn. We hope that the course is just the beginning of a journey for students, that they will continue to apply and expand what they learn for the rest of their lives. For Track C material, the most effective instruction will be *teaching for transfer*. The specific material learned is a means, not an end. Our true goal is student life-long application of the learning to unpredictable arrays of relevant situations. We

do not seek mastery of what is specifically taught; rather we desire transfer or generalization throughout the domain. This means we must provide students with opportunities to use the knowledge or skills we want them to learn; they must be active. Simply sitting and listening or memorizing is not sufficient.

4. Types of Instructional Objectives

In 1962 the publication of Mager's *Preparing Instructional Objectives* (see second edition, 1975) popularized behavioral objectives. According to Mager, behavioral objectives must:

1. state the learning outcome in terms of *terminal student behavior*,
2. indicate the *conditions* under which the behavior is to occur, and
3. specify the *standard or level of achievement* that all students must attain.

Behavioral objectives made a significant contribution to education in emphasizing what students can do as a result of learning rather than focusing on what teachers do during instruction. Making expectation explicit was also laudable.

Minimal essential objectives of this type are admirably suited to Track A material where it is possible to specify behaviorally the entire content domain and where mastery is both possible and appropriate. It makes sense in Track A to establish a standard that declares that individual differences will be channeled into the time-it-takes-to-master dimension.

In Track C, the large, open content domains are not masterable and usually are not very sequential. Students do not need to reach some arbitrary, minimum standard on one topic before progressing to the next. Here we wish to maximize student development; therefore, our Track C goals are *developmental*.

In Track C, our true goals are not usually behavioral. Rather, our objectives are typically *mentalistic*, e.g., we want students to "know," "understand," and "appreciate" the content. We cannot specify *all* the content from the large, ill-defined, open domains in behavioral terms.

To accommodate these differences between Track A and Track C, we shift our thinking from *behavioral objectives* (with minimum standards) to *behavioral indicants* of achievement (without minimum standards). This achieves the clarity of behavioral objectives without falsely claiming that Track C content is completely specifiable, is vital, is masterable, and is behavioral. Below is a comparison of the behavioral minimum essential objectives suitable for Track A and the mentalistic developmental objectives appropriate for Track C.

Behavioral Minimal Essential Objectives (Track A)

1. Are terminal student behaviors.
2. Give the conditions under which the behaviors are to occur.
3. Contain minimum standards that must be reached by each student.

Mentalistic Developmental Objectives (Track C)

1. Use terminal student behaviors only as illustrations.
2. Give the conditions under which the behaviors are to occur.
3. Avoid arbitrary standards; the greater the students' achievement, the better.

Following are examples of mentalistic developmental objectives. The first, and especially the second, were adapted from Gronlund (1985b).

1. KNOWS BASIC TERMS
   - 1.1. Matches terms that have the same meaning.
   - 1.2. Selects the term that best fits a particular definition.
   - 1.3. Arranges terms to represent hierarchical order of concepts.
   - 1.4. Selects best antonym for terms.
   - 1.5. Distinguishes among terms.
   - 1.6. Uses terms correctly orally and in writing.
   - 1.7. Gives original examples of meaning of terms.

2. USES CRITICAL THINKING SKILLS
   - 2.1. Distinguishes between facts and opinions.
   - 2.2. Distinguishes between facts and inferences.
   - 2.3. Identifies cause-effect relationships.
   - 2.4. Identifies errors in reasoning.
   - 2.5. Rates the relevance of arguments.
   - 2.6. Distinguishes between warranted and unwarranted generalizations.
   - 2.7. Formulates valid conclusions from written material.
   - 2.8. Specifies unstated assumptions needed to make conclusions true.

3. APPRECIATES MUSIC
   - 3.1. Stays awake during concerts.
   - 3.2. Orients ear toward source of music.
   - 3.3. Refrains from talking with neighbor during concert.
   - 3.4. Spends own money and time attending concerts voluntarily.
   - 3.5. Checks records and/or tapes out of library.
   - 3.6. Discusses content of major musical works and own reactions to them.

Some zealots (e.g., Mager, 1975; Popham, 1978) seem to believe that minimal essential behavioral objectives are the only valid kind of objective. Moreover, some educators (e.g., Bloom, 1976; Guskey, 1985) suggest that mastery teaching and testing strategies, shown in Track A of Table 1, should be used with all types of subject matter. In our judgment, this radical position has rendered a great disservice to education. As Cronbach (1971) noted, the concept of mastery is severely limiting; it seems to imply that one can get to the end of what it is desirable to learn. On the contrary, educational development should be open-ended and on-going. The kind of objectives and teaching and testing strategies shown in Track C of Table 1 seem far better suited to fostering educational development.

5. Types of Tests

We have identified three kinds of teaching situation Tracks and examined the appropriate manifestation of individual differences, type of subject matter, type of instruction, and type of instructional objective that is appropriate for each. In this section we shall consider the type of test that is needed to assess student learning in each of these circumstances.

The kind of test item that should be used, e.g., essay, multiple-choice, or performance, is not systematically related to the three tracks, therefore, this topic is beyond the scope of this paper. Readers who desire a treatment of this important consideration are referred to any good introductory educational measurement text, e.g., Ebel and Frisbie (1986), Gronlund (1985a), or Mehrens and Lehmann (1984). For a brief treatment of multiple-choice and essay tests see IDEA Paper No. 16 (Clegg & Cashin, 1986) and No. 17 (Cashin, 1987) respectively.

In this paper the word "test" is used as a convenient way to refer to *any assessment instrument*. Parts of this section are relevant to rating forms, questionnaires, oral tests, performance tasks, etc., as well as to paper-and-pencil tests.

Mastery Tests. Because Track A concerns specified domains of masterable essential content, Track A teaching consists of drill or practice until the student masters each element in the domain. In this case, the purpose of the test is to determine whether the student has mastered the domain.

In Track A it is appropriate to have only one form of the test for a given domain. Usually the *entire domain is tested*, e.g., the student writes all 64 forms of the Russian alphabet or performs all of the steps to load a program onto a PC. Usually it is expected that the student will get virtually all of the test items correct; if not, practice is continued until mastery is achieved. The amount of practice required will vary from student to student. The purpose of the test is to determine if each student has mastered the domain.

Discriminatory Tests. Beyond Track A, mastery testing is neither possible nor necessary. "In more advanced and less structured subjects, achievement is open-ended." Students "may progress almost without limit in such functions as understanding, critical thinking, appreciation, and originality." Subject matter may vary in content and sequence "depending upon students' "abilities, interest, and goals, as well as local instructional facilities. Under these conditions, complete mastery is unrealistic and unnecessary" (Anastasi, 1982, pp. 97–98).

In Tracks B and C, individual differences are channeled mainly into the level-of-achievement dimension. "Thus, it is appropriate and realistic to recognize and document that some people are somehow better than others at certain skills" (Cox & Dunn, 1979, p. 28). Tests of such skills need to reveal differences among students' achievement. In other words, tests must be difficult enough to reveal real individual differences among the examinees.

Discriminatory/Survey Tests. In Track C, where we have a large, open domain that can be neither tightly specified nor mastered, tests must not only *discriminate*, but must necessarily sample or survey the domain. The purpose of the sample is to make some judgment about *level of student achievement in the entire domain*.

In Track C, teaching is aimed at transfer, at students' ability to generalize their learning; therefore, repeated retesting on exactly the same material is inappropriate. Cox and Dunn provide the example of the teacher who allows the student to recycle a written composition by clarifying a point of view or correcting errors of punctuation identified by the instructor. The assumption is too often made that the student now has the ability independently to punctuate and use written communication strategies to present various viewpoints adequately. However, the student in this example may have only been parroting or following blindly what the instructor indicated should be done. "Without a demonstration of these capabilities on a new composition, unaccompanied by specific instructor guidance, there is no guarantee that the supposed learned capability truly exists" (Cox & Dunn, 1979, p. 26).

Since content sampling is at the heart of Track C testing, it is vital that the test broadly sample the domain described by the mentalistic developmental objectives and their behavioral indicants. It is beyond the scope of this paper to detail the process of planning and constructing achievement tests. The interested reader can find excellent treatment of this topic by such authors as Gronlund (1985a), or Ebel and Frisbi (1986).

6. Types of Test Interpretations

This section will first describe the two major bases of test score interpretation—domain referencing and norm referencing. Then the appropriate matching of these two means of referencing with the Tracks will be considered.

Domain Referencing. A domain-referenced (sometimes called content-referenced or criterion-referenced) interpretation indicates *how well the examinee handled certain well-identified* content. For example:

1. John correctly wrote 58 of the Russian letter forms.
2. Jane loaded program A onto Brand X PC on the first attempt.
3. Pat typed from dictation 40 words per minute with one error.

For a domain-referenced interpretation to be useful, it is crucial that it be *related to a well-defined domain* of content, skill, etc., so that the interpretation reveals *what the student can do*.

Some authors (e.g., Glaser, 1963; Popham, 1978) call this well specified content "measuring stick" a "criterion." This is perfectly correct usage of "criterion" as a "basis of comparison." However, "criterion" is also often used as "required level of achievement." To avoid this surplus meaning, we prefer to use "domain."

Norm Referencing. A norm-referenced interpretation indicates *how well the examinee performed compared to the performance of a group of other examinees*. For example:

1. Joe scored above 73 percent of the 500 students taking the Political Science 101 course final exam.
2. Chris scored at the 13th percentile on the Russian Reading Comprehension placement exam.
3. Pat—typing 40 words per minute with one error—was at the 50th percentile on the Typing 101 final exam.

For a norm-referenced interpretation to be useful, it must be related to *a well-identified and relevant group of people*, e.g., to compare Chris to people who had never been exposed to the Russian language would be meaningless.

Choosing Appropriate Bases for Interpretation. For Track A teaching, the small, closed, essential content domains call for behavioral minimal essential objectives and mastery tests. Mastery tests reveal whether or not examinees have attained a predetermined standard of competence in the specifiable and masterable domain. The interpretation given these test results must be referenced both to the content domains and to the established standard of mastery. As shown in Table 1, interpretations are therefore *domain referenced*, i.e., content referenced.

For Track C teaching, the large, open, unspecifiable, unmasterable content domains call for mentalistic developmental objectives. Achievement of such objectives is assessed by tests that survey or sample the content domain to reveal the extent of individual differences in level and scope of achievement. The interpretation given to such test results cannot be referenced to the domains because they are not tightly specifiable. They therefore must be *norm referenced*, i.e., people referenced. The interpretation must provide information concerning how the examinee's performance compares to that of a well-described relevant group of people.

7. Types of Test Scores

There are two basic types of tests scores: raw scores and derived scores.

Raw Scores are the number of *items answered correctly* on a test, e.g., John correctly wrote 58 [out of 64] Russian letter forms. **Percent** scores are closely related to raw scores, e.g., John wrote 91 percent of the letter forms correctly. In Track A, raw or percent scores are meaningful because the content domains are well-defined.

Derived Scores are obtained by converting raw scores in any of several ways to permit comparison with a group of examinees. For example, Kim obtained an SAT Verbal score of 560, or Jo ranked first in her class.

Some of the major kinds of derived scores are:
1. Grade equivalents and age equivalents;
2. Simple ranks and percentile ranks;
3. Standard scores, e.g., z-scores, T-scores, stanines, and deviation IQ's.

The one feature that all derived scores share is their capacity to render a person's performance comparable to that of other people.

In Track C, where the domains are neither tightly specifiable nor masterable, derived scores are necessary for meaningful interpretations. These interpretations *must be norm-referenced*. For example, knowing only that a student correctly answered 50 percent of the items on the Graduate Record Exam in History is meaningless. No one should conclude from that information that the student knew 50 percent of all history. That is why Educational Testing Service converts raw scores into derived scores that convey normative meaning. (Readers wishing an explanation of derived scores should consult a basic educational measurement text, e.g., Ebel and Frisbie, 1986; Gronlund, 1985a; Mehrens and Lehmann, 1984.)

Closing Comment

We hope this discussion of individual differences, subject matter, instruction, instructional objectives, tests, interpretations, and scores, will help you in making wise and consistent decisions about which parts of your courses fit the teaching, testing, and grading models of Tracks A, B, or C.

Consider, for example, a unit of instruction on the Bill of Rights. We *could* test an individual's ability to *identify* or to *recall* each of the first 10 amendments to the Constitution. But if we were concerned with the meaning, the significance, and the application of these same 10 amendments in contemporary America, how could we meaningfully define and sample from that domain? In this instance the notion of "mastery" slips through our fingers. We may question whether even the justices of the Supreme Court have really achieved complete mastery (Thorndike & Hagen, 1977, p. 168).

We hope that the distinction among the kinds of subject matter will be helpful to you. More importantly, we hope that we have made a convincing case for restricting behavioral minimum essential objectives and mastery teaching strategies to Track A material, and that for Track C material you are convinced that mentalistic developmental objectives and teaching and testing for transfer are necessary.

References and Further Readings

This paper represents a synthesis by the senior author. A 71-page monograph (Hanna, 1984), of which this IDEA paper is a distillation, is available from the Center ($5.00, prepaid). The genesis of this synthesis was an outstanding monograph by Grondlund (1985b) which interested readers are encouraged to consult.

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